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The Biodiversity of Zooplankton in Kalamukku, Cochin Estuary, Ernakulam, Kerala

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ABSTRACT :

Zooplankton forms a fundamental component of the aquatic food web and the impact of these often-tiny organisms is quite profound, influencing our lives and the planet's future. A study on the Biodiversity of Zooplankton offers a peek into what the future holds for flora and fauna of the oceans and mankind. This observational study was conducted between December 2023 and January 2024 on a sample collected from the Kalamukku , Cochin estuary , Ernakulam , Kerala, at the Central Marine Fisheries Research Institute Cochin,. The station coordinates are 9°58'54.50" N latitude 76°14'36.50" E longitude. The study aimed to estimate Zooplankton's Biodiversity through qualitative and quantitative methods. . The total zooplankton count in the station was estimated as 2.38 * 10^4 Nos/m^3. The study showed Copepods dominating the zooplankton population at the Kalamukku estuary. Other major taxonomic groups found were fish eggs, zoea , mysis , chetognaths, lucifer, cladocera , amphipods, doliolum , salpa , gastropods , bivalve pediveliger ,nauplius and megalopa .

Keywords : Zooplankton, Biodiversity , Estuary

INTRODUCTION :

Plankton are an assemblage of diverse, beautiful, often microscopic and delicate creatures that drift through the waters of the world's oceans. German researcher Victor Henson coined the name in 1887 from a Greek word 'PLANO,' meaning 'To Wander.' The plankton are incapable of independent swimming and are dictated by turbulence and currents. They include drifting animals, plants, archaea, algae, or bacteria. Plankton are primarily divided into broad functional (or trophic level) groups such as phytoplankton, zooplankton, bacterioplankton and viroplankton. Phytoplankton, which comprises the plant component of plankton, is capable of photosynthesis and, therefore, autotrophic, whereas zooplankton, the animal component of plankton, are heterotrophic.

Zooplankton impacts our lives in different ways. They play a vital role in the aquatic food web that shapes the marine ecosystem. They transfer organic energy produced by unicellular algae by photosynthesis to higher trophic levels. Commercial fish stock depends on the availability of the right zooplankton of the right size at the right place and time during the feeding period of the fish larvae. It thus impacts fish productivity and national economies as well. Zooplankton also helps to reduce anthropogenic CO2 from the atmosphere by sedimentation and burial in the sea bed. But climate change, pollution, and other anthropogenic activities adversely impact zooplankton population dynamics.

Zooplankton can be categorized into different groups according to their mode of life, size, and feeding habits. Marine zooplankton comprises a large variety of organisms with about ten thousand species. Their sizes range from tiny flagellates, a few μm large, to giant jellyfish of 2m diameter. Zooplankton are also used as bioindicators for accessing aquatic ecosystem health. Monitoring the zooplankton diversity at a site provides a better understanding of the ecological status of the water body (Baric et al., 2018). The present study was initiated to understand the zooplankton diversity near Kalamukku harbor in the Cochin estuary, Kerala.

REVIEW OF LITERATURE :

The most crucial biological community in any aquatic system is plankton, which serves as the foundation of the trophic chain (Monbet, 1992; Cloern, 1999; Sin *et al.,* 1999). They account for approximately 95% of total production in the marine ecosystem
(Satpathy *et al.,* 2010). The study of plankton communities has become increasingly Important in determining how ecosystems function (Cermeno, 2008). They play an important role in the ocean's energy exchange processes, and their significant contribution to reducing atmospheric carbon dioxide would be essential in limiting climate change and global warming (Kumar and perumal, 2012). In addition, plankton assemblages are frequently used as water quality indicators, including pollution (Satpathy *et al.,* 2010). Several workers have studied various ecological aspects of zooplankton in India (Somashekar *et al.,* 1994; Annapurna *et al.*, 1999). Zooplankton occupies a central position between the autotrophs and other heterotrophs and forms an essential link in the food web of aquatic ecosystems. The occurrence and abundance of zooplankton depend on its productivity, which is influenced by the physicochemical parameters and the level of nutrients in the water (Pawar and Pulle, 2005). The diversity and density of zooplankton populations occur in succession depending upon interspecific and intraspecific interactions and predation potential (Fernando, 1980).

Classification of Zooplankton

Based on the life pattern:

- **Holoplankton:** consists of those plants and animals that generally spend most or all of their life cycle solely within the water column. Eg: Amphipod, copepod etc.
- **Meroplankton:** Variety of aquatic organisms which have both planktonic and benthic stages in their life cycles. E g: -Cephalopods, Fish etc.

Based on the size of the plankton:

- **Micro zooplankton**-Size ranges from 20 µm to 200µm and it is the main source of production in the sea .
- **Macro Zooplankton** -Size ranges from 200 µm to 2mm

*• **Mega Zooplankton** -Size >2mm*

- **Mesoplankton** – includes organisms with size 0.2 to 20 mm
- **Nanoplankton** – size ranges from 2 to 20 ***µ***m, e.g. protists, diatoms and algae
- **Picoplankton** – size ranges from 0.2 to 2 ***µ***m, e.g. bacteria, chrysophytes
- **Femtoplankton** – includes marine viruses with size < 0.2 ***µ***m

Based on the food preference:

- **Herbivores**:-they consume phytoplankton
- **Carnivores**: -they consume small animals
- **Omnivores:**-they consume mixed diet of plant and animal material
- **Detritivores**:-they consume dead organic material

Zooplankton Sampling

The design of a plankton net is crucial in effective quantitative sampling. The amount of water that can be effectively filtered depends upon net shape, mesh size, mesh area, netting porosity, filtering area and the mesh area to mouth opening ratio. The active swimming of zooplankton out of the capture path of the net, is the most serious bias affecting the catch of larger mesozooplankton and macro zooplankton. Live zooplankton capture uses special nets with a 1 m diameter ring equipped with 333um mesh and a large 32 cm diameter by 46 cm tall cod-end bucket. There are two main types of a quantitative assessment of plankton -Biomass determinations and counting methods. Biomass measurements involve Volumetric and Gravimetric methods. Diversity indices are used to describe the quality of a zooplankton community. Shannon index and Simpson index are based on proportional abundances. Margalef's index is based in total abundance and species number

MATERIALS AND METHODS :

Area of study

The present study was conducted on a water sample collected from Kalamukku estuary, in
Ernakulam district, Kerala at 9°58’54.50”N latitude 76°14’36.50”E longitude. Qualitative analysis, taxonomic identification, and Biomass estimation were conducted on this sample during the training period from 23-12-2022 to 07-01-2023.

Fig 1: Study area: Map of Kalamukku station with coordinates

9°58’54.50”N lattitude 76°14’36.50”E longitude

Collection of zooplankton

Zooplankton samples were collected using a plankton net made of bolting silk, with mesh size of 200 um, conical in shape consisting of a ring , the filtering cone, and a collecting bucket. The collecting bucket was strong and easily removable from the net. The amount of water filtered was large and suitable for qualitative and quantitative studies. The plankton net was towed from a boat horizontally at a slow speed of 2.0 knots for 10 minutes .
The number of revolutions made by the flow meter during the haul was noted from the flowmeter. The volume of the water column through which the net travelled is then calculated using the formula $\pi r^2 h$, where r is the radius of the mouth ring and h is the known depth or the horizontal distance. By using the volume of water column and the number of revolutions made by the flow meter, the volume of water which was filtered in one revolution was found out. This calibration factor was then used to multiply the number of revolutions made at each haul for a particular station to calculate the volume of water filtered by the net.

Fixation and preservation of samples

The sample was fixed and preserved immediately after collection for taxonomic study to prevent degradation due to bacterial action, cannibalism, or chemical deterioration. Fixation was done to maintain morphological characteristics and preservation is done for maintenance of the fixed condition for long periods of time. The collected samples were preserved in 4% buffered formalin- made by adding 200 g of buffer such as Borax or hexamethylenetetramine to one litre of concentrated formalin.

Analysis of the samples

A subsample is taken for enumeration. Folsom plankton splitter was used for subsampling. By this, the sample was divided into two halves at a time. This dividing process was done two times. For counting, standard methods were used by pippeting out 10 ml of the sample and counting– the top row, two rows in the middle, and the bottom row were counted using a counting chamber and the total number calculated. The samples were observed under a stereo zoom microscope (Leica S8APO), and different zooplankton groups were identified and enumerated using standard taxonomic books. The count of organisms per m^3 of water was calculated. The zooplankton groups were manually separated under a stereo zoom microscope using forceps and counted and sorted before dropping them in separate petri dishes. The counts in the subsample was raised to the total volume since the numbers have to be expressed in per m^3 of water by considering the volume of water filtered by the net during sampling.

Fig 1: Bongo net

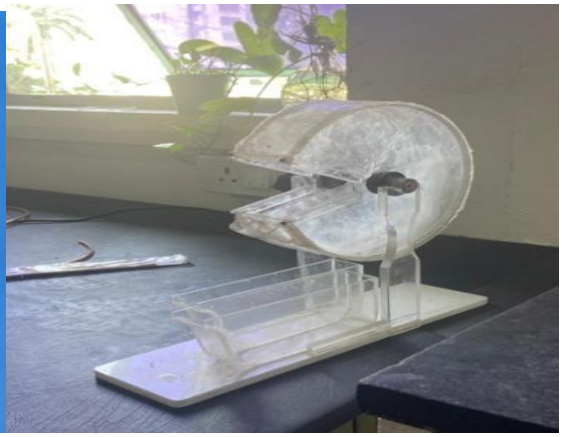

Fig 2:Folsom splitter

Fig 4: Towing of Zooplankton

Fig 5: Flow meter

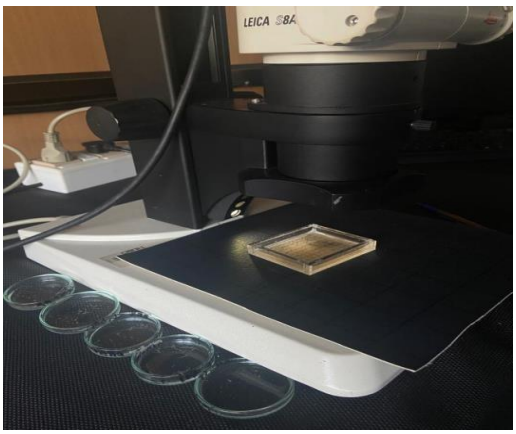

Fig 7:Enumeration of zooplankton

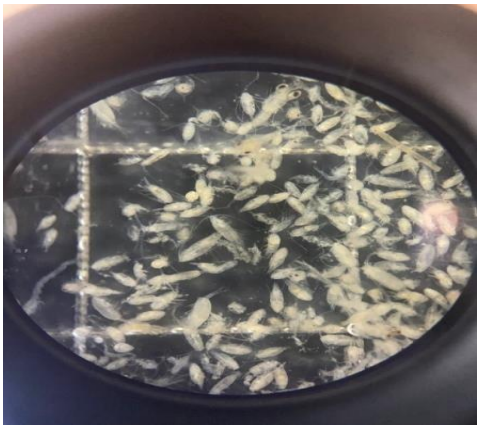

Fig 8:Sample placed in the counting chamber

RESULTS :

The different taxa of zooplankton identified during the present study are given in Table 1. A total of 17 groups were identified from the estuary stations. Copepods were the most dominant among the zooplankton groups based on the estuary station count. The total zooplankton count in the station was estimated as $2.38 * 10^4$

Table 1 : Zooplankton groups identified from the Kalamukku sample

Zooplankton taxa	Estimated Nos/m^3
Chaetognatha	160
Mysidae	80
Cladocera	64
Amphipod	72
Lucifer	120
Copepod	22,540
Doliolum	32
Salpa	16
Gastropod	16
Bivalve Pedivelliger	40
Megalopa	8
Mysis	176
Nauplius	32
Zoea	240
Fish Larvae	8
Fish Eggs	256
Total	**23860**

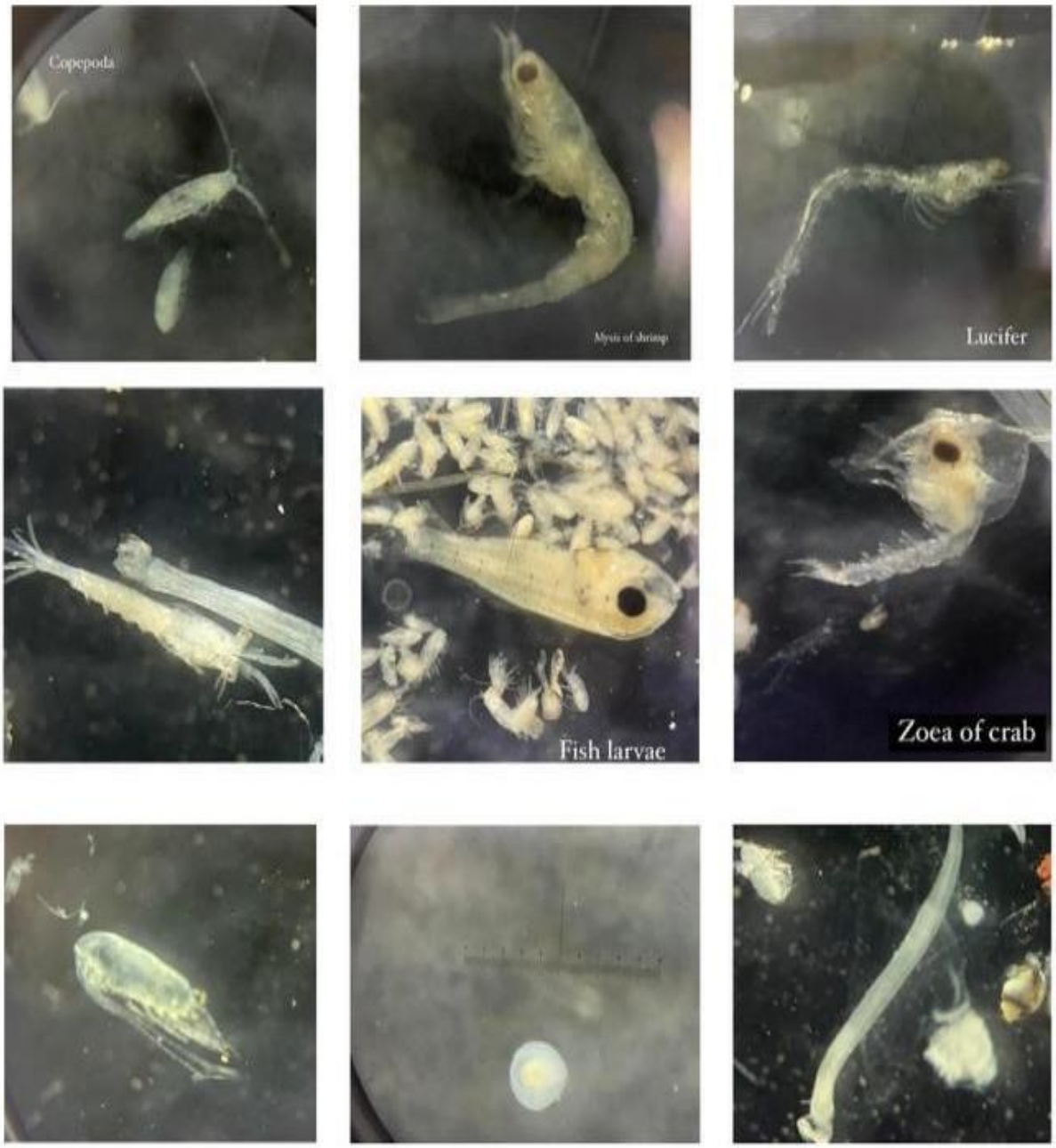

Fig 9: Photos of zooplankton groups identified on stereo zoom microscope.(1.copepod 2.mysis of shrimp,lucifer,mysis,fish larva,zoea,copepod,fish egg,chaetognatha)

The study showed Copepods dominating the zooplankton population at the Kalamukku estuary. Other major taxonomic groups found were fish eggs, zoea , mysis , chetognaths, lucifer, cladocera , amphipods, doliolum , salpa , gastropods , bivalve pediveliger ,nauplius and megalopa .

DISCUSSION :

This study on the biodiversity of zooplankton in an estuary in Ernakulam District, Kerala found domination of copepod. The density of zooplankton varied from 0.34-6.55 x 10^4 individuals per m^3. Copepods dominate the oceans of the world and the dominance in the Cochin estuary could be a reflection of its worldwide distribution. The tropical estuary with high salinity, especially during the PR monsoon months is quite conducive for rapid growth of copepods. salpa and doliolum were identified in the sample. They are usually found in the marine environment. They are sessile and filter-feeders. The greater salinity of the estuary at the time of sampling could explain the presence of these essentially marine zooplankton and high

abundance of copepods in the estuary Cochin estuary. This area may also be a breeding ground for many fishes as many fish eggs and larvae were also found.

Another study conducted on zooplankton collected between year 2000 and 2002 -Distribution of Zooplankton in selected centres of Cochin backwaters, Kerala conducted by Varghese, Molly and Krishnan, L (2009) also found 17 zooplankton groups. Among the different groups of zooplankton available in this area, a maximum of 52% composed of rotifers, followed by copepods which formed 40%. The findings of this study corroborate the finding of Copepod dominance in the estuaries of Ernakulam district, Kerala.

CONCLUSIONS :

Qualitative analysis of a sample of water collected from Kalakukku, Cochin estuary, Ernakulam district showed 17 taxonomic groups with a predominance of Copepods, comprising 98%. The total zooplankton count in the station was estimated as $2.38 * 10^{4\ Nos}/m^{3.}$ The findings of this study correlated with previous studies conducted in multiple stations in the estuaries of Cochin.

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